

Chemical Burns : the place of Diphotérine®

L. MINARO¹, R. BEDRY², C. VERDUN ESQUER¹, P. BROCHARD¹, J.C. FAVAREL GARRIGUES²

¹ Occupational Health and Professional Pathology Department, Pellegrin Hospital, place Amélie-Raba-Léon, 33076 Bordeaux Cedex

² Poison Center, Pellegrin Hospital, place Amélie-Raba-Léon, 33076 Bordeaux Cedex

DEFINITION

The chemical burn is characterised by a deterioration of sane tissues after a chemical reaction between product and tissue.

EPIDEMIOLOGY

Chemical burns only represent 3 to 5% of all burns. In the companies, 70% of burns have a chemical origin, which shows the importance of the prevention and the place of first aid. The products involved are mainly acids (32%) and bases (26%).

MECHANISMS OF THE CHEMICAL BURN

Six reactions are responsible for chemical burns : acido basic reactions, oxydo reduction reactions, addition, substitution, chelation and solvation reactions.

The seriousness will essentially depend on 4 criteria :

- the aggressive character of the product : it is defined by its intrinsic activity (oxydo reduction potential for oxidizers and reducing agents, solubility rate for solvents, pK for acids and bases)
- the concentration of the product : a caustic product will be corrosive for a concentration higher than 1N
- the quantity of product involved : for the eye, the maximum quantity involved is 0,2ml because of the palpebral reflex and the ocular surface
- the time of contact : this is a characteristic of chemical burns, until the link tissue-caustic is broken, the destructive action goes on.

THE DIFFERENT KINDS OF CHEMICAL BURNS

We can divide the chemical products in 2 groups : the ones that provoke only local signs, more or less serious (nitric acid, potassium hydroxide...) and the ones that can provoke systemic effects (hydrofluoric acid, oxalic acid, phenol...)

TREATMENT OF THE CHEMICAL BURN

We will only discuss the pre hospital treatment, as the treatment from a distance fits in with the one for other burns and become a specialist job.

It is an emergency. The therapeutic has to be started where the accident happened : take off all soaked clothes, take off contact lenses in case of ocular burn, decontamination with tap water. Most authors recommend a rinsing during 20 minutes or more. Water is the only emergency treatment recommended in the literature.

As a reminder we can cite the 10-15 rule :

- cool water (10-15°C)
- flowing at 10-15 cm from the burn
- during at least 10-15 minutes

Effect of water on the burn :

- dilution of the xenobiotic, but this action appears as very limited for 2 reasons : first its hypotonicity would encourage the penetration of the product according to the osmotic balance laws, and the dilution of the product with water is low
- mechanical sweeping effect that washes away the xenobiotic that stayed on the surface
- antalgic effect due to the diminution of the inflammation mediators liberation, which limits the perilesional oedema and diminishes the size and the depth of the lesion.

ALTERNATIVE TO THE EMERGENCY TREATMENT WITH WATER : DIPHOTERINE®

Since 1988, Prevor laboratory is selling a new rinsing solution called Diphotérine®. It is an amphoteric molecule that has at least one active antagonistic site to the 5 reactions that create the chemical burn. In addition, the solution is slightly hypertonic, which tends to stop the flux of solvent. The neutralisation of the product induces a quasi insignificant exothermic reaction.

VALUATION OF DIPHOTERINE® EFFICACY

Very few studies were carried out on Diphotérine®. The most important one is the one from P. Josset *et al.* who studied the penetration of a base (soda) in the eyes of 68 rabbits according to the first aid applied : water, isotonic solution, amphoteric and slightly hypertonic solution (Diphotérine®).

The study of the extra ocular pH shows after a rinsing with water during 3 minutes a value of 9,7 with a return to the physiological level in 60 minutes, when with Diphotérine® the physiological pH is obtained immediately. The intra

ocular physiological pH is obtained after 35 minutes with the water rinsing when it is immediate with Diphotérine[®] ;

The microscopic analysis shows a complete destruction of the epithelium whatever the rinsing method is. Finally the endothelial cells destroyed with the water rinsing are 95% preserved with a Diphotérine[®] rinsing.

Several studies in the companies allowed to evaluate the evolution of burns according to the first aid used. The Konrad *et al.* team compared several rinsing methods after accidents due to caustic soda and showed a significant difference in terms of decrease of secondary care and days lost from work with Diphotérine[®]. Finally Falcy (INRS), in a national study on the different ways to treat a chemical burn could not statistically privilege a treatment in particular (water or Diphotérine[®]).

DISCUSSION

Water is the consensual treatment for chemical burns and presents the advantage to be easy to use with a mechanical sweeping effect associated to an antalgic effect. The drawbacks of its use are due to its hypotonicity which would ease the penetration of the product, its low dilution power, finally the possibility of serious ocular lesions even if the treatment was well conducted.

Diphotérine[®], with its multiple action mechanism, allows a neutralisation of the product without any exothermic reaction, with a quick pain relieve, the slight hypertonicity allows a decrease of the product penetration. Unfortunately, the small number of published studies does not allow to make a clear idea of the advantage of this product compared to water.

CONCLUSION

Chemical burns represent a tiny part of all the burns, but one of their characteristic is that you can find them mainly in the companies.

The consensual emergency treatment is still water, for the skin or the eyes, because of the lack of alternatives.

Diphotérine[®] seems very interesting according to its action mechanism and the first published results. The lack of available information forbids for the moment to advise it systematically for every chemical burns. We will undoubtedly hear about it in the following years, at the end of studies that are now carried out.

Anyway, the potential seriousness of chemical burns and the few ways to fight against should incite to study this device in details.